

$$\lim_{x \rightarrow \infty} -xe^{-x} \quad \infty \cdot 0 = 0$$

$$\lim_{x \rightarrow \infty} \frac{-x}{e^x} \quad \frac{\infty}{\infty} = 0$$

$$\lim_{x \rightarrow \infty} \frac{-1}{e^x} = 0$$

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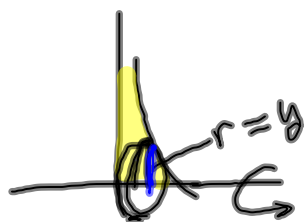
$$\int_0^1 \ln x \, dx \quad x \ln x - \int x \frac{1}{x} dx$$

$$\begin{aligned} u &= \ln x & dv &= dx & & = x \ln x - x \\ du &= \frac{1}{x} dx & v &= x \end{aligned}$$

$$\begin{aligned} \lim_{b \rightarrow 0^+} \int_b^1 \ln x \, dx &= \lim_{b \rightarrow 0^+} x \ln x - x \Big|_b^1 \\ &= \lim_{b \rightarrow 0^+} (1 \ln 1 - 1) - (b \ln b - b) \\ &= -1 - \lim_{b \rightarrow 0^+} \frac{\ln b}{1/b} \\ &= -1 - \lim_{b \rightarrow 0^+} \frac{1/b}{-1/b^2} \\ &= (-1) - \lim_{b \rightarrow 0^+} \frac{1}{b} \left(-\frac{b^2}{1} \right) = \lim_{b \rightarrow 0^+} -b = 0 \\ &= -1 \end{aligned}$$

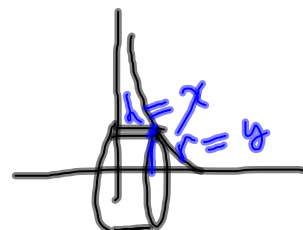
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$$y = -\ln x$$

$$e^{-y} = x$$



$$\int_0^1 \pi r^2 dx = \pi \int_0^1 (-\ln x)^2 dx$$

$$\int 2\pi xy dy$$

$$\int_0^{\infty} 2\pi e^{-y} y dy$$

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44.

$$\int_3^{\infty} \frac{2}{x^2-2x} dx$$



$$\int_3^{\infty} \frac{2}{x(x-2)} dx = \lim_{b \rightarrow \infty} \int_3^b \frac{-1}{x} + \frac{1}{x-2} dx$$

$$= \lim_{b \rightarrow \infty} -\ln|x| + \ln|x-2| \Big|_3^b$$

$$= \lim_{b \rightarrow \infty} -\ln b + \ln(b-2) - (-\ln 3 + \ln 1)$$

$$\lim_{b \rightarrow \infty} \ln\left(\frac{b-2}{b}\right)$$

$$\ln A - \ln B = \ln\left(\frac{A}{B}\right)$$

$$0 + \ln 3 + 0$$

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